Ecological site DX034A07X122
Loamy Platte Valley (Ly PV)

Last updated: 9/28/2023
Accessed: 04/24/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 034A–Cool Central Desertic Basins and Plateaus

34A-Cool Central Desertic Basins and Plateaus
For further information regarding MLRAs, refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

Land Resource Unit (LRU) 34A-I:
(Please refer to LRU document for further explanation)
Moisture Regime: aridic ustic
Temperature Regime: frigid
Dominant Cover: rangeland
Representative Value (RV) Effective Precipitation: 9-12 inches
RV Frost-Free Days: 90-120 days

Classification relationships

Site Name: Loamy Platte Valley

Site Type: Rangeland

Site ID: R034AI122WY

Precipitation or Climate Zone: 9-12” P.Z.
National Vegetation Classification System (NVC):
3 Semi-Desert
3.B.1 Cool Semi-Desert Scrub & Grassland
D040 Western North American Cool Semi-Desert Scrub & Grassland
M169 Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe Group
CEGL001043 *Artemisia tridentata* ssp. wyomingensis / *Elymus elymoides* Shrubland

Ecoregions (EPA):
Level I: 10 North American Deserts
Level II: 10.1 Cold Deserts
Level III: 10.1.4 Wyoming Basin

Ecological site concept

Site does not receive any additional water.
Soils are:

not saline or saline-sodic.
moderately deep, deep, with < 3% stone (10-25”) and boulder (>25”) cover.
not skeletal within 20” of soil surface.
not strongly or violently effervescent in surface mineral 10”.
textures usually range from very fine sandy loam to clay loam in surface mineral 4”.
Slope is < 15%.
Clay content is = <32% in surface mineral 4”.
Site does not have an argillic horizon with > 35% clay

Associated sites

DX034A05X122	**Loamy Beaver Rim (Ly BR)**
R034AY322WY	**Loamy High Plains Southeast (Ly)**

Similar sites

R034AY350WY	**Sandy High Plains Southeast (Sy)**
R034AY304WY	**Clayey High Plains Southeast (Cy)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. wyomingensis*
Herbaceous	(1) *Hesperostipa comata* (2) *Koeleria macrantha*

Legacy ID

R034AH122WY

Physiographic features

The Loamy Platte valley (Ly) ecological site (R034AI122WY) is located within LRU “I” in MLRA “34A.” This ecological site occurs in intermontane basin landscapes on hill, draw, pediment, and fan remnant landforms (see definitions below). The slope ranges from level to 15%. This site occurs on all aspects.
fan remnant – A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected (erosional fan-remnants) or partially buried (nonburied fan-remnants). An erosional fan remnant must have a relatively flat summit that is a relict fan-surface.
intermontane basin – A generic term for wide structural depressions between mountain ranges that are partly filled with alluvium and called "valleys" in the vernacular.
hills – A landscape dominated by hills and associated valleys. The landform term is singular (hill).

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan remnant
Flooding frequency	None
Ponding frequency	None
Elevation	6,500–7,500 ft
Slope	0–15%
Water table depth	60 in
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 9-12 inches per year. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures.

Much of the precipitation accumulation (45%) comes in the spring/summer(April to August). The wettest month is May (1.22 inches). The growing season is short (90-120 days average) and cool: primary growth typically occurs between May and June. The dominant plants (sagebrush and cool season grasses) are well adapted to these conditions.
Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

Growth of native cool season plants begins about mid-April and continues to approximately early-July. Some green up of cool season plants usually occurs in September with adequate fall moisture.

Table 3. Representative climatic features

Frost-free period (average)	99 days
Freeze-free period (average)	119 days
Precipitation total (average)	10 in

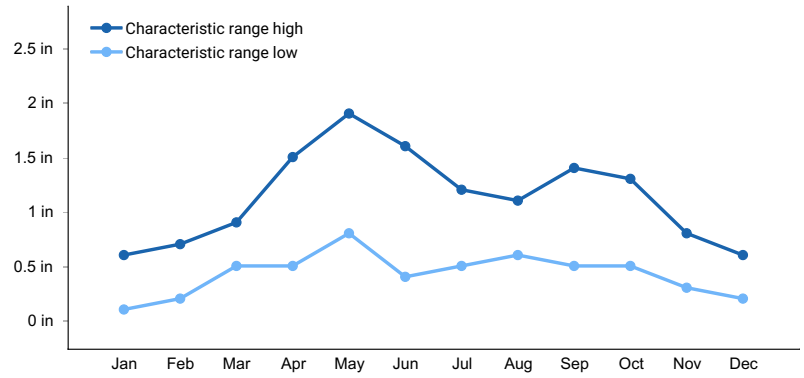


Figure 1. Monthly precipitation range

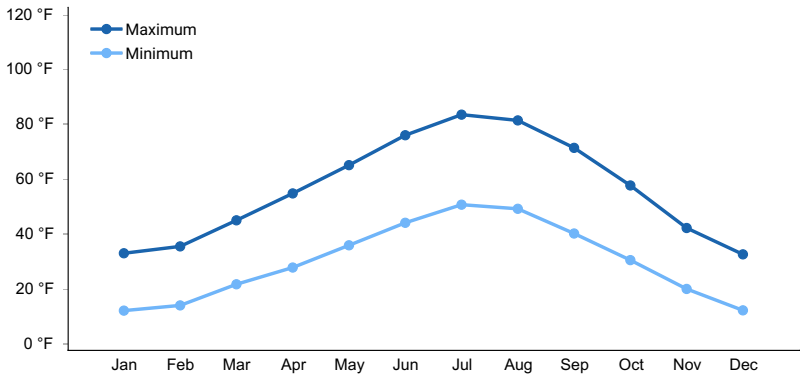


Figure 2. Monthly average minimum and maximum temperature

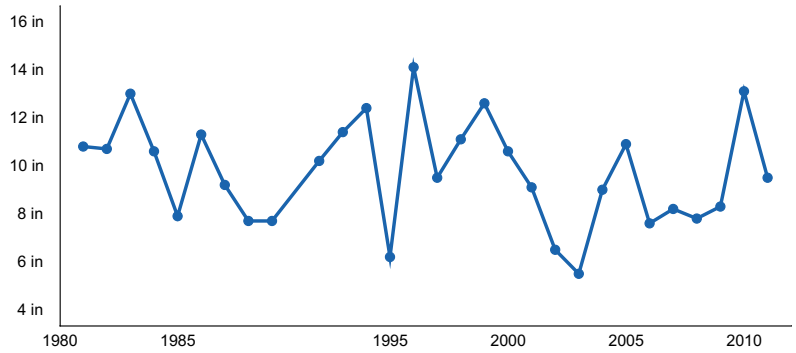


Figure 3. Annual precipitation pattern

Climate stations used

- (1) SARATOGA [USC00487990], Saratoga, WY
- (2) RAWLINS MUNI AP [USW00024057], Rawlins, WY

Influencing water features

None

Soil features

The soils of this site are moderately deep to very deep(greater than 20" to bedrock), and well-drained. Textures range from loams to very fine sandy loam on the coarse end to light clay loam (<30% clay content) on the heavy end. The most common textures include loam, silt loam, and sandy clay loam. A highly common scenario is to have a 1 to 3” cap of sandy loam over a sandy clay loam due to young soil development of weathered sandstone and shale parent materials.

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and shale
Surface texture	(1) Gravelly fine sandy loam (2) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Soil depth	20–60 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3–7.5 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–25%

Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

This ecological site is dominated (species composition by dry weight) by big sagebrush and perennial grasses with forbs as a minor component. The site consists of five states: the Reference State (1), Grazing Resistant State (2), Eroded State (3), Disturbed State (4), and Highly Disturbed State (5).
The Reference State is a collection of 3 distinct Plant Communities that exist on a continuum relative to disturbances, primarily grazing, pests, drought, and fire with no disturbance causing successional changes as well over time. These Plant Communities represent the best adapted plant communities to the soils and climate found on the site, and they represent the best estimation of ecological dynamics present on this site at the time of European settlement.
The Reference Plant Community (big sage/bunchgrass) of this site is dominated by Wyoming big sagebrush (*Artemisia tridentata* var. wyomingensis) and cool-season perennial bunchgrass species, primarily Needleandthread (Hesperostipa comat)and muttongrass(Poa fenderilana) with bottlebrush squirreltail (*Elymus elymoides*),and rhizomatous grasses like thickspike wheatgrass (*Elymus lanceolatus* ssp. lanceolatus) as a subdominant. Minor components include short-statured bunchgrasses such as Sandberg bluegrass perennial forbs, and shrubs, including green rabbitbrush (*Chrysothamnus viscidiflorus*).
After a sagebrush killing disturbance, the Plant Community transitions to the Bunchgrass Plant Community which is dominated by the mid-stature bunchgrasses mentioned above. Sagebrush is a minor component of this Plant Community, and only time without a sagebrush killing disturbance will advance this to the Bunchgrass/ big sagebrush which is an intermediate Plant Community described because of the time this site spends with this species composition, its value to resource managers, and often it is the most prone to some sagebrush killing disturbances, such as fire, which are thought be fairly infrequent on this site.
The Bunchgrass/big sagebrush Plant Community, as a mid-seral stage, is often considered to have the most diversity and provide the most ecosystem services (i.e. wildlife habitat, livestock forage, etc.) in a multiple use management system.
Mid- stature bunchgrasses act as decreaser species in the Reference Community. Low stature bunchgrasses and rhizomatous grasses tolerate higher grazing pressure and grow on less fertile soils (USDA/NRCS 2007) than mid stature bunchgrasses. They often fill in the vegetation gaps created when mid stature bunchgrasses decline, hence they are collectively referred to as increaser species.
Big sagebrush, is the dominant shrub on this site. Most often Wyoming big sagebrush is the sub-species present. Snow catchment is a significant hydrologic component of this site, and the hydrology changes when shrubs are removed from this site.

Without ground disturbing activities, this site is relatively free of invasive weeds, but once mechanically or physically disturbed it is prone to weed invasion, primarily by annuals such as bushy birdsbeak (*Cordylanthus ramosus*), lambsquarter (*Chenopodium album*), Russian thistle (*Salsola kali*), flixweed (*Descurainia sophia*), and kochia (*Bassia scoparia*). The most common noxious species affecting this site after soil disturbance is whitetop (Cardraria draba) and Canada thistle (*Cirsium arvense*) at the upper end of its precipitation range. Soil disturbance can be caused by vehicles, equipment, severe over-utilization of the herbaceous vegetation, or large amounts of bare ground created by extended drought conditions combined with over-utilization. Cheatgrass, and invasive annual grass from the Mediterranean region, has been found on sites with higher gravel content that have been severely disturbed (roads, gravel pits, etc.).

A State and Transition Model (STM) for the Loamy ecological site (34AI122WY) is depicted in Figure 1. Thorough descriptions of each state, transition, plant community, and pathway are found after the model in this document. This model is based on available experimental research, field observations, professional consensus, and interpretations. While based on the best available information, the STM will change over time as knowledge of ecological processes increases.

Plant communities within the same ecological site differ across the LRU due to the naturally occurring variability in weather, soils, and aspect. Not all managers will choose the reference community as the management goal. Other plant communities may be desired to meet land management objectives. This is valid as long as the Rangeland Health attributes assessment departures are slight to moderate or none to slight for the Reference State. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or

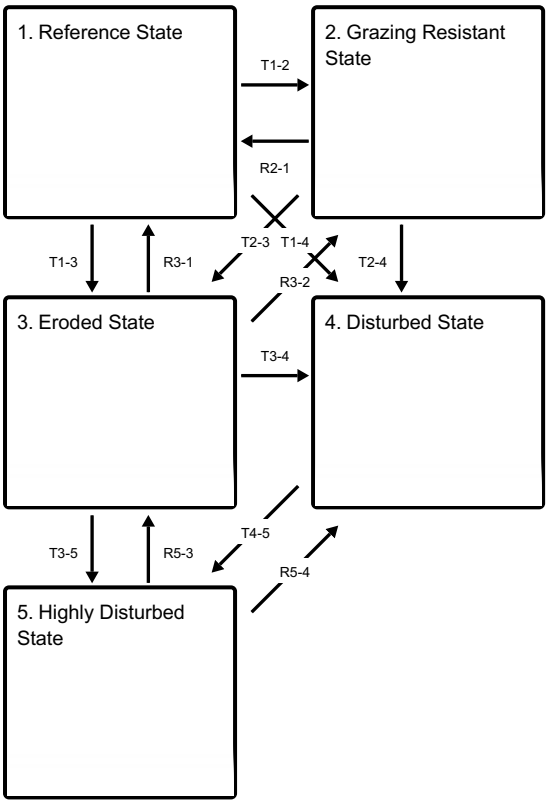
potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are used in this ESD. Foliar cover drives the transitions between communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight remains an important descriptor of the herbaceous community and of site productivity as a whole. Woody species are included in species composition by weight for the site. Calculating similarity index requires use of species composition by dry weight.

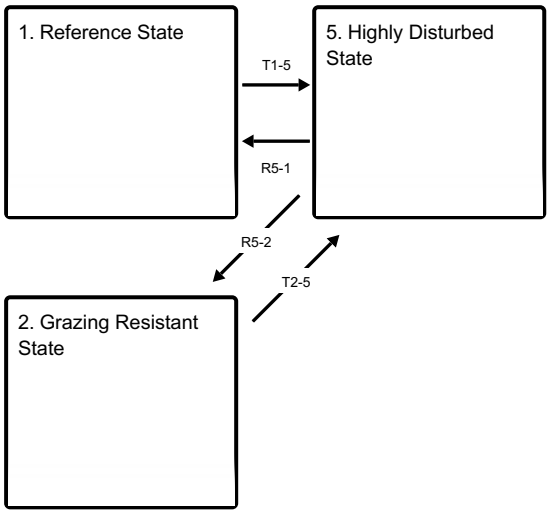
Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), no quantitative information exists that specifically identifies threshold parameters between reference states and degraded states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2004, Bestelmeyer and Brown 2005, Stringham et al. 2003.

State and transition model

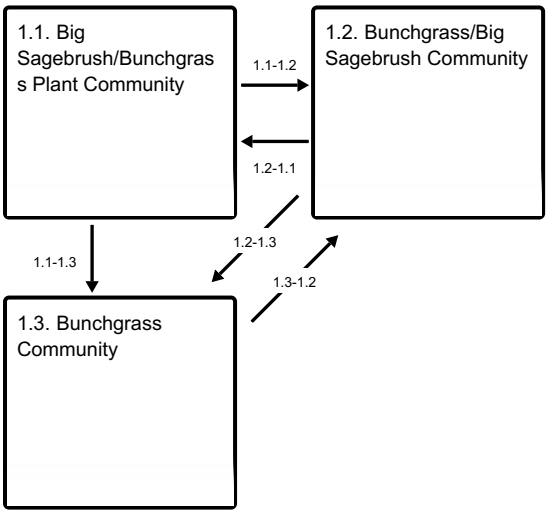
Ecosystem states



States 1, 5 and 2 (additional transitions)

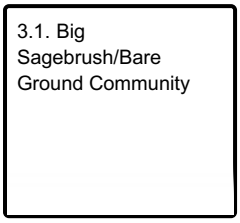


State 1 submodel, plant communities

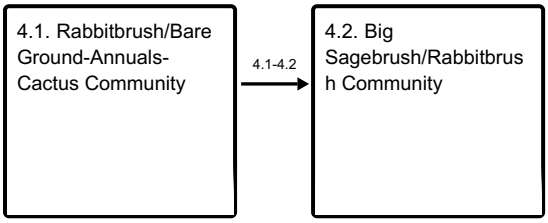


State 2 submodel, plant communities

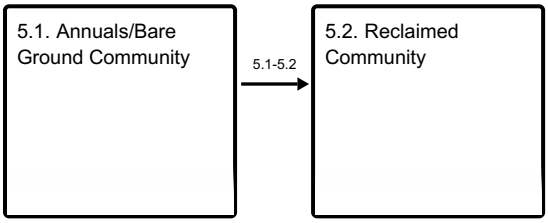
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference State

The Reference State consists of three Plant Communities: the Big Sagebrush/Bunchgrass Community (1.1) the Bunchgrass/Big sagebrush Plant Community (1.2) and the Bunchgrass Community (1.3). Each community differs in percent composition of bunchgrasses and percent woody canopy cover. Forbs are a minor component on this site. Woody canopy cover is less than 30 percent. Dominant shrub species is Wyoming Big Sagebrush in the Reference State (1), with some instances of, mountain big sagebrush at the upper end of the precipitation range. Two important processes occurring in this state result in plant community changes within Reference State: sagebrush killing disturbances (browse, insects, drought, fire) and time without those disturbances. These processes are generally referred to as “natural succession.” The shift from the Bunchgrass Plant Community (1.3) to the Bunchgrass/Big Sagebrush Plant Community (1.2) and subsequently to the Big Sagebrush/Bunchgrass Plant Community is dependent on an increase of woody cover. Without sagebrush killing disturbance, shrubs will increase on this ecological site even with proper grazing management. This is generally a long-term process, although, improper grazing management may accelerate the rate of increase for woody species. The shift from the Big Sagebrush/Bunchgrass or Bunchgrass/Big Sagebrush Plant Communities is dependent on sagebrush killing disturbances such as fire, drought, browse, and insects. Management actions can and are often used to mimic these processes through mechanical and chemical treatments. Prescribed fire is not often used on this site due to current land uses and lack of fuels and adequate burn windows.

Community 1.1
Big Sagebrush/Bunchgrass Plant Community

Figure 5. 1.1

The Loamy site has the potential to be one of the most productive upland sites in the LRU. The Big Sagebrush/Bunchgrass Plant Community is well adapted to Cool Central Desertic Basins and Plateaus climatic conditions. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. These plants have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Adequate plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site. This plant community provides for soil stability and a properly functioning hydrologic cycle. The soils associated with this site are fertile and hold moderately large amounts of soil moisture, providing a very favorable soil-water-plant relationship. Chemical treatment of shrubs has replaced natural sagebrush killing events on many sites in the area. However, chemical treatments may impact non-target species, particularly broad-leafed species (forbs and shrubs) differently than natural events such as drought or fire. This was particularly true when 2-4D was the chemical of choice, however, 2-4D is seldomly used currently. Where fire tends to result in a short-term increase in forbs, some chemical treatments result in a short-term (or medium-term) reduction in forb density and diversity. The Big Sagebrush/Bunchgrass Community (1.1) can occur across the entire ecological site or can occur in a mosaic. This community can occur over time without these disturbances and accelerated with added herbaceous grazing pressure. Big sagebrush is dominant in the Big Sagebrush/Bunchgrass Community (1.1) with sagebrush canopy cover ranging from 15% to 25%. At this sagebrush canopy level in this precipitation zone, there is competition between the shrub overstory and the herbaceous understory. (Winward, 2007) A Big Sagebrush/Bunchgrass Community with a degraded understory is an “at-risk” community. In the Big Sagebrush/Bunchgrass Community (1.1), there are generally few canopy gaps, and most basal gaps are moderate (1-2 feet). Rock cover on the soil surface is essentially nonexistent. Many plant interspaces have canopy or litter cover. Production of grasses is much lower than in the Bunchgrass Community (1.3) and slightly lower than in the Bunchgrass/Big Sagebrush Community (1.2). It is typical for shrubs to increase as the community shifts from the Bunchgrass Community (1.1) to the Bunchgrass/Big Sagebrush Community (1.2).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	250	350	450
Shrub/Vine	200	280	360
Forb	50	70	90
Total	**500**	**700**	**900**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%

Biological crusts	0%
Litter	40-60%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-30%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	20-55%	2-15%
>0.5 <= 1	–	–	20-55%	2-5%
>1 <= 2	–	25-35%	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

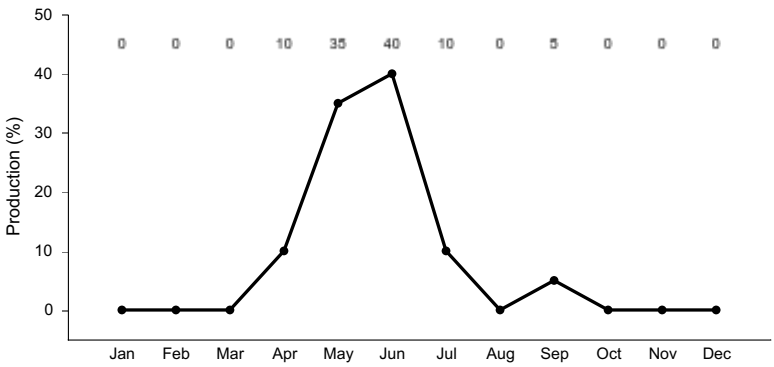


Figure 7. Plant community growth curve (percent production by month). WY0901, 34AI, Upland Sites. All Upland Sites.

Community 1.2
Bunchgrass/Big Sagebrush Community

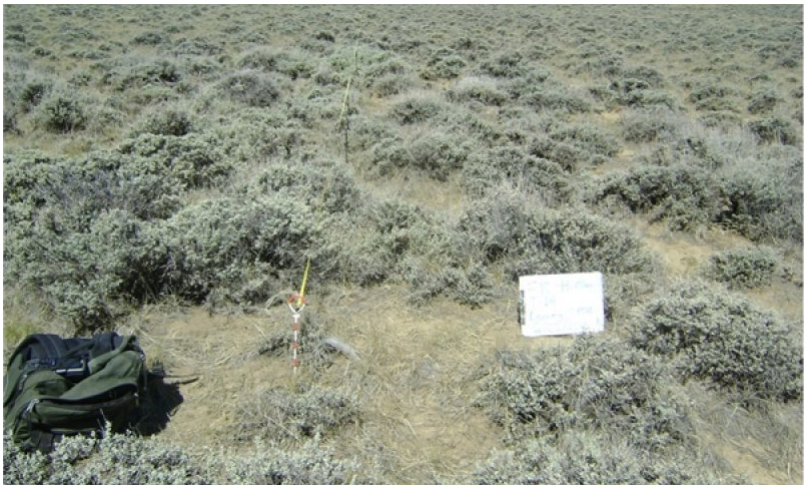


Figure 8. 1.2

The Bunchgrass/Big Sagebrush Community (1.2) can occur across the entire ecological site on a given landscape but more likely occurs in a mosaic pattern associated with the disturbance cycle at any given location. Mid-stature bunchgrasses dominate in the Bunchgrass/Big Sagebrush Community (1.2) with sagebrush sub-dominant with cover ranging from 5% to 15%. At this sagebrush canopy level in this precipitation zone, there is little if any competition between the shrub overstory and the herbaceous understory. In fact, there is evidence to suggest that the understory receives more benefit from the sage overstory than negative effects. (Winward, 2007) In the Bunchgrass/Big Sagebrush Community (1.2), there are generally few canopy gaps, and most basal gaps are generally (1-2 feet). Rock cover on the soil surface is essentially nonexistent. Many plant interspaces have canopy or litter cover. Production of grasses is slightly lower than in the Bunchgrass Community (1.3), but shrub production is higher.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	350	490	630
Shrub/Vine	100	140	180
Forb	50	70	90
Total	**500**	**700**	**900**

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	45-65%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	15-25%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	20-55%	2-15%
>0.5 <= 1	–	–	20-55%	2-5%
>1 <= 2	–	5-15%	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

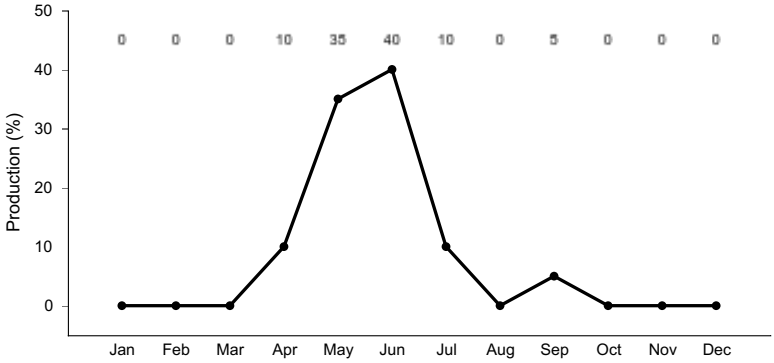


Figure 10. Plant community growth curve (percent production by month). WY0901, 34AI, Upland Sites. All Upland Sites.

Community 1.3
Bunchgrass Community

Figure 11. 1.3

The Bunchgrass Community (1.3) is dominated by mid-stature cool-season bunchgrasses mixed with a minor component of forbs and shrubs. Big sagebrush is present as a part of the community, but is minor with 0 to 5% foliar cover. Other shrubs, such as, rabbitbrushes may increase and will vary in longevity within the plant community. The Bunchgrass Community (1.3) generally occurs on this site immediately following a sagebrush killing event such as drought, insects, browse, or fire.

Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	400	560	720
Shrub/Vine	50	70	90
Forb	50	70	90
Total	**500**	**700**	**900**

Table 12. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%

Litter	30-50%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	10-20%

Table 13. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	25-60%	2-15%
>0.5 <= 1	–	0-5%	25-60%	2-5%
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

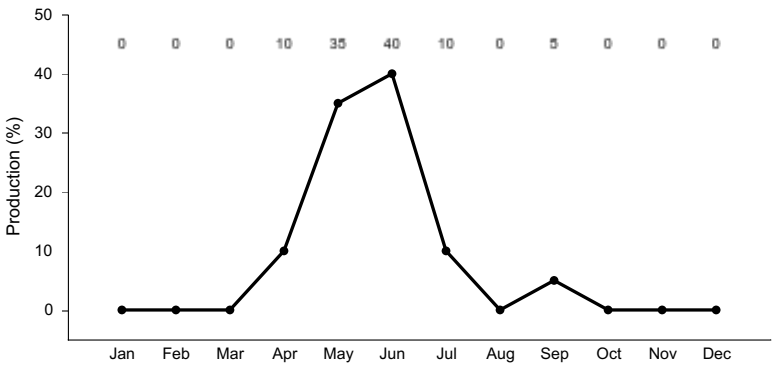
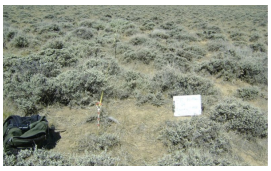


Figure 13. Plant community growth curve (percent production by month). WY0901, 34AI, Upland Sites. All Upland Sites.

Pathway 1.1-1.2
Community 1.1 to 1.2

Big Sagebrush/Bunchgrass Plant Community



Bunchgrass/Big Sagebrush Community

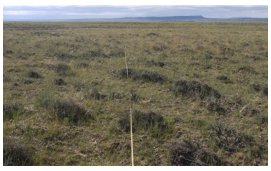
The trigger for a community shift from the Big Sagebrush/Bunchgrass Community (1.1) to the Bunchgrass/Big Sagebrush Community (1.2) is a sagebrush thinning event, such as drought, insects, disease, chemical, mechanical or biological control of sagebrush that favors the existing herbaceous vegetation while only removing a portion of the sagebrush canopy so that 5-15% sagebrush cover remains. Indicators include the increase in density and vigor of mid-stature bunchgrasses to the point that they co-dominate species composition by weight with Wyoming big sagebrush.

Conservation practices

Brush Management

Pathway 1.1-1.3
Community 1.1 to 1.3

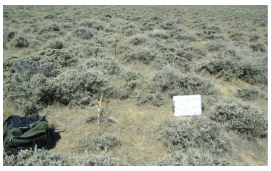
Big Sagebrush/Bunchgrass Plant Community



Bunchgrass Community

The trigger for a community shift from the Big Sagebrush/Bunchgrass Community (1.1) to the Bunchgrass Community (1.3) is a stand replacing sagebrush killing event, such as fire, drought, insects, disease, chemical, mechanical or biological control of sagebrush that favors the existing herbaceous vegetation and removes sagebrush canopy to <5%. Indicators include the increase in density and vigor of mid-stature bunchgrasses to the point that they dominate species composition by weight.

Pathway 1.2-1.1
Community 1.2 to 1.1



Bunchgrass/Big Sagebrush Community

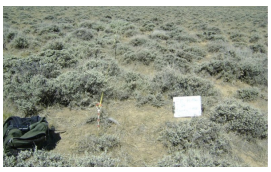
Big Sagebrush/Bunchgrass Plant Community

The trigger for a community shift from the Bunchgrass/Big Sagebrush Community (1.2) to the Big Sagebrush/Bunchgrass Community (1.1) is natural succession, or lack of disturbance over time. Indicators include an increase in shrub cover and decline in overall under-story.

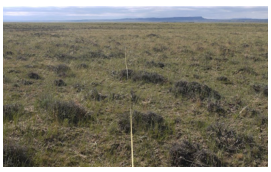
Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Pathway 1.2-1.3
Community 1.2 to 1.3



Bunchgrass/Big Sagebrush Community



Bunchgrass Community

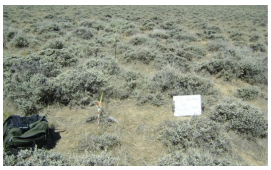
The trigger for a community shift from the Bunchgrass/Big Sagebrush Community (1.2) to the Bunchgrass Community (1.3) is a sagebrush killing event, such as fire, drought, chemical, mechanical or biological control of sagebrush that favors the existing herbaceous vegetation. Indicators include an increase in density and vigor of mid-stature bunchgrasses to the point that they dominate species composition by weight.

Conservation practices

Brush Management

Pathway 1.3-1.2
Community 1.3 to 1.2

Bunchgrass Community



Bunchgrass/Big Sagebrush Community

The trigger for a community shift from the Bunchgrass Community (1.3) to the Bunchgrass/Big Sagebrush Community (1.2) is natural succession, or lack of disturbance over time. Indicators include an increase in shrub cover and decline in overall under-story. Natural succession results in sagebrush cover increasing in response to annual climatic differences and a certain amount of herbivory. Succession can be accelerated with proper herbaceous grazing (fully stocked and a system that varies the time and timing of grazing to provide for periodic deferment during the critical growth period) and natural events such as drought/wet cycles.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Grazing Resistant State

The Grazing Resistant State (2) is characterized by an herbaceous layer dominated by short-statured bunchgrasses such such as Sandberg bluegrass and, rhizomatous grasses and grass-likes, and/or mat forbs such as Hood's phlox, pussytoes, and sulfur flowered buckwheat. Mid-stature bunchgrasses such as Indian ricegrass, needleandthread, muttongrass, and bottlebrush squirreltail have become scarce or absent and are commonly found under sagebrush plants. There is an increase in green rabbitbrush along with annual forbs and cheatgrass. There is one community in the Grazing Resistant State: the Big Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass - Mat Forb Plant Community (2.1). The site crosses the threshold to the Grazing Resistant State (2) from the Reference State (1) when desirable mid-stature bunchgrasses lose dominance. Once the key species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The Plant Community in the Grazing Resistant State (2) is very resilient and therefore common on Loamy sites in this MLRA. In many cases, the transition to the Grazing Resistant State (2) may have occurred many decades ago during an era of higher stocking rates and continuous grazing during the growing season. However, continual grazing during the critical growth period (roughly May-June) at proper stocking rates will facilitate the transition to this state and maintain it in a stable state. While dominance by rhizomatous grasses makes the return to the Reference State (1) plant community difficult, it also makes the site resistant to further degradation except in cases where overstocked or in the case of prolonged drought with full stocking. The main factor creating high resiliency of the Big Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community is that the bluegrass and rhizomatous grasses are highly grazing tolerant. Sandberg bluegrass and rhizomatous grasses are low to the ground, so, even under heavy grazing, enough biomass remains for the grasses to maintain plant vigor. Rhizomatous grasses successfully reproduce through underground rhizomes. The rhizomatous grasses can form mats that provide soil protection by protecting the soil from raindrop impact, decreasing the risk of soil erosion. However, overall soil health is lower than the reference state, primarily due to a reduction in soil organic matter due to a reduction in litter. The decreased infiltration is due increased bare ground patch size and lack of litter that acts as mulch in retaining soil moisture and retarding runoff. Under high intensity early season grazing, especially by in calving pastures and in small acreage horse pastures, ground cover decreases to a point that the site will transition to the *Bare Ground* State (3).

Community 2.1
Big Sagebrush/Rhizomatous Wheatgrass- Bluegrass-Annuals Plant Community

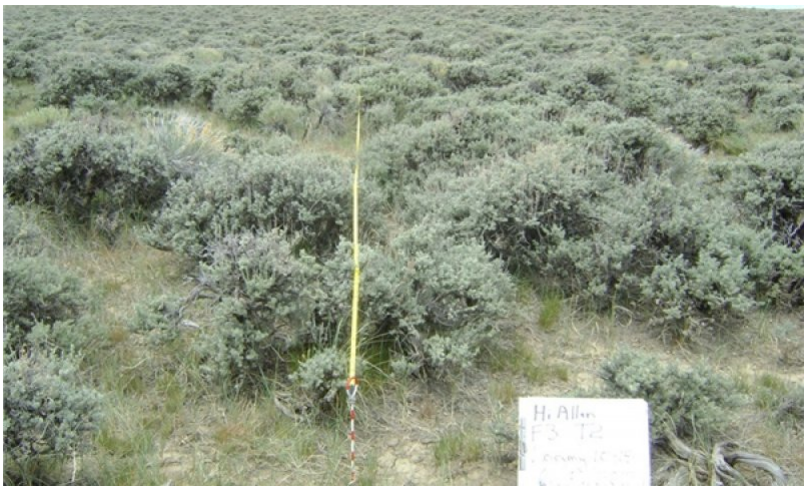


Figure 14. 2.1

The Big Sagebrush/Rhizomatous Wheatgrass-Bluegrass-Annuals Plant Community (2.1) is characterized by an herbaceous component dominated by Sandberg bluegrass, rhizomatous wheatgrass and/or mat forbs, with limited mid-stature bunchgrasses. Once these key species becomes scarce, it is unlikely to have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The plant community is highly resilient to changes in composition, due to the dominance and competition of established bluegrass, rhizomatous wheatgrass, and/or mat forbs. However, the community can shift back to the Big Sagebrush/Bunchgrass Community (1.3) over time with fire and/or brush control and/or deferment. This community is shrub dominated. Sagebrush canopy may be as high as 25 percent or higher. The dominant shrub is Wyoming big sagebrush. The Big Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Community occurs if the herbaceous component has been degraded. Areas that catch and retain snow are more likely to have higher shrub cover. Range Health Indicators: Production is considerably lower than in Reference State (1), leading to lower soil organic matter content and therefore lower soil stability than in the Reference State. Ground cover is still high. Infiltration is lower than in the Reference State and the water cycle has reduced function due to decreased soil organic matter.

Table 14. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	100	200	325
Grass/Grasslike	80	160	260
Forb	20	40	65
Total	**200**	**400**	**650**

Table 15. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	45-65%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-40%

Table 16. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	20-40%	2-10%
>0.5 <= 1	–	–	20-40%	2-5%
>1 <= 2	–	15-30%	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

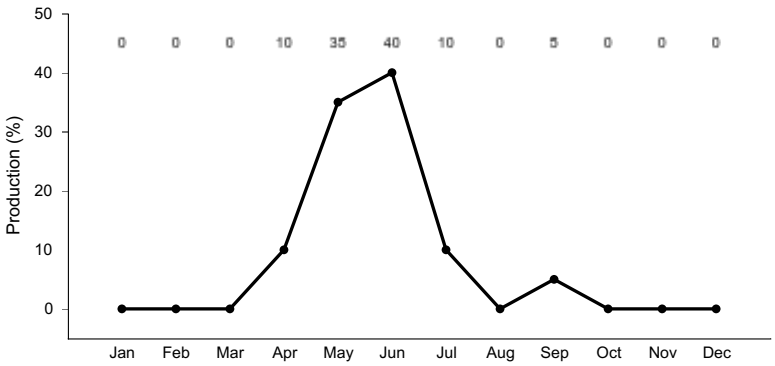


Figure 16. Plant community growth curve (percent production by month). WY0901, 34AI, Upland Sites. All Upland Sites.

State 3
Eroded State

Herbaceous canopy cover in the Big Sagebrush/*Bare Ground* Community (3.1) is significantly reduced. Annual production is approximately half of the Bunchgrass Plant Community (1.1). Perennial bunchgrasses (e.g., Indian ricegrass, bottlebrush squirreltail, and needleandthread) exist only in low densities and protected under the sagebrush canopy. This community tends to be dominated by Wyoming big sagebrush (>25% cover) and bare ground in large connected patches in the interspaces of the shrub canopy. The majority of annual production is from big sagebrush so this site provides very little value for grazing. Sufficient quantity of fine fuels necessary to carry a fire. Therefore, fire is no longer a driver of ecological dynamics. Sparse vegetation creates low levels of foliar and basal cover. This, in turn, leads to low litter production, which is combined with reduced ability to retain litter on site. Soil is exposed to wind and water erosion in the plant interspaces. These factors combine to create a decrease in soil organic matter. Reduced litter cover, combined with reduced herbaceous cover, results in higher soil temperature, poor water infiltration rates, and high evaporation, thus favoring species which are more adapted to drier conditions. Soil fertility is reduced, soil compaction is increased, and resistance to soil surface erosion has declined compared to the other states. This community has lost most, if not all, of the attributes of a functioning, healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling, and energy flow. This state commonly occurs in feeding areas, salting locations and confined horse pastures.

Community 3.1
Big Sagebrush/Bare Ground Community

Herbaceous canopy cover in the Big Sagebrush/*Bare Ground* Community (3.1) is significantly reduced. Annual production is approximately half of the Bunchgrass Plant Community (1.1). Perennial grass species (e.g., Indian ricegrass and needleandthread, Letterman's needlegrass) may exist only under sagebrush canopy and are typically

low in vigor. This community tends to be dominated by big sagebrush (>25% cover) and bare ground in large patches in the interspaces of the shrub canopy. The majority of annual production is from big sagebrush so this site provides very little value for grazing. The Big Sagebrush/*Bare Ground* Community (3.1) rarely produces sufficient quantity of fine fuels necessary to carry a fire. Therefore, fire no longer influences community dynamics. The Big Sagebrush/*Bare Ground* Community (3.1) differs from other communities, because it is characterized by sparse plant cover and soil surface erosion. Sparse vegetation creates low levels of foliar and basal cover. This, in turn, leads to low litter production, which is combined with reduced ability to retain litter on site. Soil is exposed to wind and water erosion in the plant interspaces. These factors combine to create a decrease in soil organic matter. Reduced litter cover, combined with reduced herbaceous cover, results in higher soil temperature, poor water infiltration rates, and high evaporation, thus favoring species which are more adapted to drier conditions. Soil fertility is reduced, soil compaction is increased, and resistance to soil surface erosion has declined compared to the other states. This community has lost most, if not all, of the attributes of a functioning, healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling, and energy flow.

Table 17. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	50	150	250
Grass/Grasslike	40	120	200
Forb	10	30	50
Total	**100**	**300**	**500**

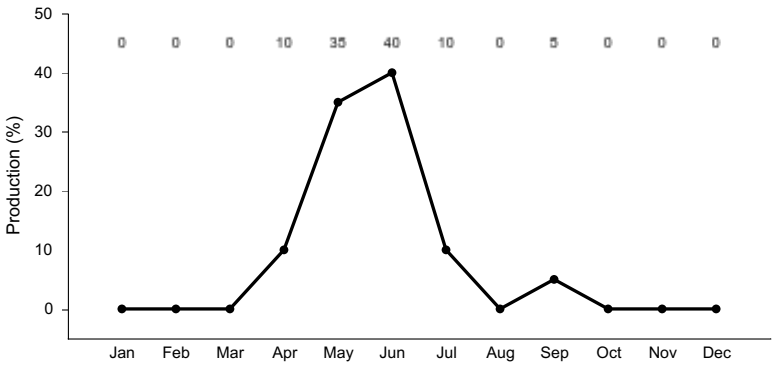


Figure 18. Plant community growth curve (percent production by month). WY0901, 34AI, Upland Sites. All Upland Sites.

State 4
Disturbed State

This state is characterized by the amount of rabbitbrush invasion on the site. It also has a component of annual forbs and substantial bare ground. Is occurs with multiple sagebrush killing events in rapid succession outside the normal disturbance regime for this site (see Reference State for discussion). It could be mechanical (including heavy equipment/construction or a mowing/chaining/harrow type sage treatment), chemical (including 2,4-D or tebuthiron), or biological (including browse and/or insects). Fire could be a factor in maintaining this plant community perpetually by stimulating sprouting shrubs (rabbitbrush) and killing sagebrush. This is usually only a concern annual weeds are prolific on the site during wet cycles that boost their production. Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the upper soil horizon. Consequences of this are decreased soil fertility or even soil erosion, soil crusting, and decrease of soil surface aggregate stability.

Community 4.1
Rabbitbrush/Bare Ground-Annuals-Cactus Community

The Rabbitbrush/Rhizomatous Wheatgrass Community (4.1) is often in a perpetual state of disturbance. The disturbance regime of the site has been accelerated often with the addition of ground disturbing activities (i.e. gravel pits, pasture corners where livestock are gathered, continual sagebrush removal techniques, and/or consecutive fires). Seeding and long-term grazing management may restore functional structural groups, but rabbitbrush is likely

to continue as a dominant shrub into the foreseeable future with no restoration pathway identified at this time due to irreversible changes to soil dynamic properties (structure, organic matter, infiltration, bulk density, and/or water holding capacity).

Community 4.2
Big Sagebrush/Rabbitbrush Community

The Big Sagebrush/Rabbitbrush Community (4.2) has had the disturbance regime accelerated or altered in the past, but no recent sagebrush killing events. Wyoming big sagebrush and green rabbitbrush are co-dominant with a sparse understory. This community is found in areas of historical disturbance (i.e. homesteads, gravel pits, emigrant trails) where the disturbances that caused the initial dominance of rabbitbrush have ceased

Pathway 4.1-4.2
Community 4.1 to 4.2

The trigger for a community shift from the Rabbitbrush/Rhizomatous Wheatgrass Community (4.1) to the Big Sagebrush/Rabbitbrush Community (4.2) is time without sagebrush killing disturbances. This shift can be accelerated with high utilization levels by grazers, particularly during the critical growth period.

State 5
Highly Disturbed State

As part of succession, all sites that are severely disturbed will go through this plant community as part of their restoration. Weather is the largest determining factor in how long a site will be in this plant community phase, but is approximately 2-5 years on sites that use Best Management Practices for site restoration (http://www.uwyo.edu/wrrc/). Site has low potential for recovery. Seeding is needed to restore functional structural groups.

Community 5.1
Annuals/Bare Ground Community

The Annuals/*Bare Ground* Community (5.1) occurs after severe disturbance, most often physical soil disturbance that removes all topsoil, but it can also occur as a transition from the Eroded State (3) after severe drought, flooding, pests, or disease kills sagebrush, leaving the site with no perennial vegetation. Populations of annual and/or invasive weeds reach critical levels and impact the ecological processes on the site until restoration of the site occurs. As part of succession, all sites that are severely disturbed will go through this plant community as part of the restoration process. .

Community 5.2
Reclaimed Community

The Reclaimed Community (5.1) is highly variable based on weather conditions during restoration activities, the management practices used to implement the restoration, the seed mix, and timing/method of stockpiling topsoil during the disturbance. The most common scenario is a reclaimed oil and gas well pad planted to crested wheatgrass (Agropyron cristata) without appropriate topsoil stockpiling. If topsoil is stockpiled, it may have been stored for too long and/or stored too deep resulting in fewer soil microorganisms. Over time, Wyoming big sagebrush will spread into the reclaimed area, but the understory will be dominated by introduced species.

Pathway 5.1-5.2
Community 5.1 to 5.2

The trigger for a community shift from the Annuals/*Bare Ground* Community (5.1) to the Reclaimed Community (5.2) is a variety of reclamation and restoration techniques that include seedbed preparation, seeding, and often post-planting weed control. Weather is the largest determining factor in determining time and success, but the process can be accelerated with Best Management Practices for site restoration (http://www.uwyo.edu/wrrc/).

Transition T1-2
State 1 to 2

The driver for transition from the Reference State to the Grazing Resistant State (T1-2) is continuous spring grazing and/or long-term drought. Continuous spring grazing and/or extended drought can lead to a decline in palatable mid-stature bunchgrasses. Indian ricegrass, a short-lived perennial that requires more frequent seed production to provide an adequate seedbank, and bluebunch wheatgrass, a long-lived perennial that has elevated growth points, are typically the first species to decline (Natural Resources Conservation Service). Bottlebrush squirreltail will also decline with grazing pressure and lack of disturbances that kill sagebrush. Needleandthread is more grazing tolerant, but will eventually decline in plant density and vigor. As bunchgrasses diminish or die during periods of stress, low- stature bunchgrasses and rhizomatous grasses gain a competitive advantage, creating a shift in species composition towards less productive, shorter species. While bare ground may not change significantly, the pattern of bare ground will shift to larger gaps in the canopy and fewer herbaceous plants between shrubs. Many of the remaining desirable bunchgrasses will be only found in the understory of the shrub canopy. Once mid-stature bunchgrasses species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or re-sprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. When the understory vegetation has been degraded to this point, the transition to the Grazing Resistant State (2) can occur from either the Bunchgrass/Big Sagebrush Plant Community (1.2) or the Big Sagebrush/Bunchgrass Plant Community (1.1). The transition is not dependent on the increase of woody canopy cover, but rather on the lack of mid-stature bunchgrasses in the canopy interspaces. Management should focus on grazing management strategies that will prevent further degradation. This can be achieved through a grazing management scheme that varies the season of use to provide periodic deferment during the critical growth period (roughly May-June). Forage quantity and/or quality in the Grazing Resistant State (2) may be substantially reduced compared to the Reference State, and will dramatically fluctuate in dry vs. wet years.

Transition T1-3
State 1 to 3

The driver for transition from the Reference State to the Eroded State (T1-3) is continuous high intensity early season grazing. Drought can accelerate this transition. Indicators of this transition include significant decline in plant canopy cover or total annual aboveground biomass production below 200 pounds per acre. The primary indicator of this transition is the loss of understory, which creates open spots with bare soil between the sagebrush canopy. Soil erosion causes decreased soil fertility and infiltration, triggering the transition to the Eroded State. Several other key factors signal the approach of a threshhold: an increase in soil physical crusting, a decrease in soil surface aggregate stability, and/or evidence of erosion, including water flow patterns, development of pedestals, and litter movement

Transition T1-4
State 1 to 4

The driver for transition from the Reference State to the Disturbed State (T1-4) is an increase in the disturbance cycle (i.e. grazing, drought, fire, mechanical, chemical or biological treatments), often in combination with grazing management that does not provide periodic deferment during the critical growth period. The transition can occur if multiple soil disturbing activities occur over a relatively short time period. This could be high intensity/high frequency grazing, machinery, and/or multiple sagebrush treatments. Indicators include an increase in rabbitbrush to dominant levels in the plant community due to ground disturbance that could be either natural (i.e. water movement) or manmade (i.e. high density/high frequency stocking, mechanical treatments or heavy equipment operations). If introduced to the site, invasive species, such as cheatgrass, may be present. To prevent this transition, the site will require proper reclamation after disturbance using the most current science and technology available to restore native vegetation and prevent invasive dominance. In cases where topsoil loss occurs, it may be unavoidable to prevent this transition. Long-term stress conditions for native species (e.g., improper grazing management, drought, and fire) will alter plant community composition and production over time and may hasten the transition. The resulting lower biomass production, reduced litter, and increased bare ground in this community can promote invasion of undesirable species.

Transition T1-5
State 1 to 5

The driver for transition from the Reference State to the Highly Disturbed State (T1-5) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

Restoration pathway R2-1
State 2 to 1

The drivers for this restoration pathway are reduction of woody species and restoration of native herbaceous species by mechanical or chemical treatment of sagebrush, and grazing rest or deferment. If some mid- stature bunchgrasses remain under the sage canopy, proper grazing management can move the site back to the Reference State (1) combined with a mechanical or chemical sagebrush treatment. Most probable restoration pathway is from Big Sagebrush/Rhizomatous Wheatgrass Community (2.1) to the Bunchgrass Community (1.3). This could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment. (Derner, Schuman, Follett, & Vance, 2014).

Transition T2-3
State 2 to 3

The driver for transition from the Grazing Resistant State to the Eroded State (T2-3) is continuous high intensity early season grazing from the Big Sagebrush/Rhizomatous Wheatgrass Community (2-1). Examples include calving pastures and small acreage horse pastures where rotational grazing is not employed, but stocking densities are high. Extended drought periods accelerate this transition. Indicators include very old sagebrush stands with very little understory between the sagebrush canopy. Bare ground patch sizes are very large and comprise the majority of the interspaces between sagebrush plants.

Transition T2-4
State 2 to 4

The driver for transition from the Grazing Resistant State to the Disturbed State (T2-4) is an increase in the disturbance cycle (i.e. grazing, drought, fire, mechanical, chemical, biological treatments) combined with continuous high intensity grazing. Examples include calving pastures and small acreage horse pastures where rotational grazing is not employed combined with sagebrush treatment (mechanical, chemical, or biological). High stocking densities are soil disturbing, and adding sagebrush treatment(s) to this regime result in an increase in the disturbance cycle. Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the upper soil horizon, and the site can degrade to the Disturbed State (4). Consequences of this transition are decreased soil fertility or even soil erosion, soil crusting, and decrease of soil surface aggregate stability. Indicators of the Disturbed state are a shift in shrub dominance away from sagebrush and toward sprouting shrubs such as green rabbitbrush (*Chrysothamnus viscidiflorus*).

Transition T2-5
State 2 to 5

The driver for transition from the Grazing Resistant to the Highly Disturbed State (T2-5) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

Restoration pathway R3-1
State 3 to 1

The Eroded State (3) has lost soil or vegetation attributes to the point that recovery to the Reference State (1) will require a combination of grazing management (changing season of use to allow frequent rest or deferment during the critical growth period) and chemical, biological or mechanical treatments, and reseeding. Seeding may be cost prohibitive as a restoration practice used alone. With reduced organic matter and loss of soil, soil amendments and/or mulch may be needed for restoration success. Restoration has occurred by mowing without re-seeding, but the grazing regime in this instance is low stocking density and winter only use.

Restoration pathway R3-2
State 3 to 2

Restoration from the Eroded State (3) to the Grazing Resistant State (2) is possible with mechanical, biological and chemical treatments and temporary rest or deferment post-treatment. Due to loss of soil fertility, structure, and organic matter, reference community plants are slow to repopulate the site. Success of this restoration is highly dependent upon climatic factors, and may require successive wet years. This restoration pathway is often unintentionally achieved when the goal is the Reference State (1) because post-treatment management is not sustained in a manner that allows frequent critical growth period rest and/or use levels and recovery periods are not adequate to sustain mid-stature bunchgrasses.

Transition T3-4
State 3 to 4

The driver for this transition is a sagebrush killing event with continuous high intensity early season grazing. The event could be severe drought, flooding, insects, disease, or a sagebrush treatment such as mechanical (including heavy equipment/construction or a mowing/chaining/harrow type sage treatment), chemical (including 2,4-D or tebuthiron), or biological (including browse and/or insects). Fire is not usually possible due to lack of understory fuels to carry the fire. In fact, the Eroded State (3) is characterized by monotypic decadent sagebrush stands because they are fireproof.

Transition T3-5
State 3 to 5

The driver for transition from the Reference State to the Highly Disturbed State (T1-5) is a topsoil removing event with mechanical equipment, but it can also occur after severe drought, flooding, pests, or disease kills sagebrush, leaving the site with no perennial vegetation. Examples include construction sites, oil and gas activity, and borrow areas. Evidence of climate as a cause for this transition has been captured after the 2012 drought (Clause & Randall, 2015).

Transition T4-5
State 4 to 5

The driver for transition from the Disturbed State to the Highly Disturbed State (T4-5) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

Restoration pathway R5-1
State 5 to 1

The Highly Disturbed State (5) can be restored to the Reference State (1) if appropriate seedbed preparation and seed mixes are used, and weather conditions are conducive to seedling establishment. Weather is the largest determining factor in determining time and success, but the process can be accelerated with Best Management Practices for site restoration (http://www.uwyo.edu/wrrc/). There is low potential for recovery without significant inputs of energy and resources if topsoil has been removed. Seeding is needed to restore functional structural groups, and proper seedbed preparation is key to restoring ecological processes on the site.

Restoration pathway R5-2
State 5 to 2

The Highly Disturbed State (5) is often restored to the Grazing Resistant State (2) unintentionally when inappropriate seed mixes are used and post-seeding grazing does not provide adequate and periodic critical growth period rest. Weather is the largest determining factor in determining time and success, but the process can be accelerated with Best Management Practices for site restoration (http://www.uwyo.edu/wrrc/). There is low potential for recovery without significant inputs of energy and resources if topsoil has been removed. Seed mixes that mimic an adjacent “reference area” rather than the site potential as described in the Reference State (1) will often result in a plant community resembling the Grazing Resistant State (2) due to past and post-seeding grazing management of the area.

Restoration pathway R5-3

State 5 to 3

The Highly Disturbed State (5) can transition the Eroded State (3) if disturbed areas result in total topsoil removal and are abandoned and climate is favorable for seedling establishment. Wyoming big sagebrush will eventually colonize the site, but because soil conditions are severely altered, little to no under-story can be found. An example of this transition can be found on abandoned oil and gas wells that are 30+ years old where topsoil was not stockpiled and re-spread on the site after proper contouring and ripping, and either no seeding was done or the planting was a failure. If topsoil was not physically removed, and there is a viable seedbank in the soil, recovery is possible without re-seeding as long as adequate rest from herbivory is provided to allow seedling establishment. Rest from herbivory is recommended during dry years to prevent further soil loss as well as in wet years to allow seedling establishment.

Restoration pathway R5-4
State 5 to 4

The Highly Disturbed State (5) can transition the Disturbed State (4) if disturbed areas result in only partial topsoil removal, leaving rootstock available for sprouting species such as rabbitbrush. This is common for gravel pits and areas disturbed as stockpile areas where soil is placed on the area for any amount of time, and then removed with equipment that scraps some of the soil surface during the removal process.

Additional community tables

Table 18. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Grasses**			105–210	
	needle and thread	HECO26	*Hesperostipa comata*	35–105	5–15
	prairie Junegrass	KOMA	*Koeleria macrantha*	35–105	5–15
	muttongrass	POFE	*Poa fendleriana*	0–35	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–35	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	7–35	1–5
	squirreltail	ELEL5	*Elymus elymoides*	0–35	0–5
2	**Rhizomatous Grasses**			35–70	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	35–70	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	35–70	5–10
3	**Misc. Grasses/Grasslikes**			35–70	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–35	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–35	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	21–35	3–5
	Grass, perennial	2GP	*Grass, perennial*	0–35	0–5
Forb					
4	**Perennial Forbs**			28–63	
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	21–56	3–8
	buckwheat	ERIOG	*Eriogonum*	7–35	1–5
	rockcress	ARABI2	*Arabis*	0–21	0–3
	milkvetch	ASTRA	*Astragalus*	0–21	0–3
	spiny phlox	PHHO	*Phlox hoodii*	7–21	1–3
	violet	VIOLA	*Viola*	0–21	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–21	0–3

	goldenweed				
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–7	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–7	0–1
	sagebrush buttercup	RAGL	*Ranunculus glaberrimus*	0–7	0–1
	larkspur	DELPH	*Delphinium*	0–7	0–1
	fleabane	ERIGE2	*Erigeron*	0–7	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–7	0–1
	desertparsley	LOMAT	*Lomatium*	0–7	0–1
	lupine	LUPIN	*Lupinus*	0–7	0–1
	bluebells	MERTE	*Mertensia*	0–7	0–1
	beardtongue	PENST	*Penstemon*	0–7	0–1
	onion	ALLIU	*Allium*	0–7	0–1
	pussytoes	ANTEN	*Antennaria*	0–7	0–1
5	**Annual Forbs**			0–7	
	rockjasmine	ANDRO3	*Androsace*	0–7	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–7	0–1
	Forb, annual	2FA	*Forb, annual*	0–7	0–1
Shrub/Vine					
6	**Shrubs**			84–175	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	84–175	15–25
7	**Misc Shrubs**			49–105	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–35	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–35	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–35	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–7	0–1
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–7	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–7	0–1
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–7	0–1
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–7	0–1

Table 19. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid Size Cool Season Grasses**			161–350	
	needle and thread	HECO26	*Hesperostipa comata*	35–140	5–20
	prairie Junegrass	KOMA	*Koeleria macrantha*	35–140	5–20
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	7–70	1–10
	muttongrass	POFE	*Poa fendleriana*	7–35	1–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–35	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–35	0–5
2	**Rhizomatous Grasses**			35–70	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	35–70	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	35–70	5–10

3	**Misc. Grasses/Grasslikes**			35–70	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–35	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–35	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	21–35	3–5
	Grass, perennial	2GP	*Grass, perennial*	0–35	0–5
Forb					
4	**Perennial Forbs**			28–63	
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	7–35	1–5
	buckwheat	ERIOG	*Eriogonum*	7–35	1–5
	rockcress	ARABI2	*Arabis*	0–21	0–3
	milkvetch	ASTRA	*Astragalus*	0–21	0–3
	spiny phlox	PHHO	*Phlox hoodii*	7–21	1–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–21	0–3
	violet	VIOLA	*Viola*	0–21	0–3
	Forb, perennial	2FP	*Forb, perennial*	0–7	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–7	0–1
	sagebrush buttercup	RAGL	*Ranunculus glaberrimus*	0–7	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–7	0–1
	larkspur	DELPH	*Delphinium*	0–7	0–1
	fleabane	ERIGE2	*Erigeron*	0–7	0–1
	desertparsley	LOMAT	*Lomatium*	0–7	0–1
	lupine	LUPIN	*Lupinus*	0–7	0–1
	bluebells	MERTE	*Mertensia*	0–7	0–1
	beardtongue	PENST	*Penstemon*	0–7	0–1
	onion	ALLIU	*Allium*	0–7	0–1
	pussytoes	ANTEN	*Antennaria*	0–7	0–1
5	**Annual Forbs**			0–7	
	rockjasmine	ANDRO3	*Androsace*	0–7	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–7	0–1
	Forb, annual	2FA	*Forb, annual*	0–7	0–1
Shrub/Vine					
6	**Shrubs**			49–105	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	49–105	10–15
7	**Misc Srubs**			14–35	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–35	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–35	0–5
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–21	0–3
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–7	0–1
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–7	0–1
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–7	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–7	0–1
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–7	0–1
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–7	0–1

	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–7	0–1

Table 20. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Grasses**			161–350	
	needle and thread	HECO26	*Hesperostipa comata*	70–140	10–20
	prairie Junegrass	KOMA	*Koeleria macrantha*	70–140	10–20
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	35–105	5–15
	squirreltail	ELEL5	*Elymus elymoides*	0–35	0–5
	muttongrass	POFE	*Poa fendleriana*	7–35	1–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–35	0–5
2	**Rhizomatous Grasses**			49–105	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	35–70	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	35–70	5–10
3	**Misc. Grasses/Grasslikes**			49–105	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–35	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–35	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	7–35	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–35	0–5
Forb					
4	**Perennial Forbs**			28–63	
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	21–56	3–8
	buckwheat	ERIOG	*Eriogonum*	7–35	1–5
	rockcress	ARABI2	*Arabis*	0–21	0–3
	milkvetch	ASTRA	*Astragalus*	0–21	0–3
	spiny phlox	PHHO	*Phlox hoodii*	7–21	1–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–21	0–3
	violet	VIOLA	*Viola*	0–21	0–3
	Forb, perennial	2FP	*Forb, perennial*	0–7	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–7	0–1
	sagebrush buttercup	RAGL	*Ranunculus glaberrimus*	0–7	0–1
	larkspur	DELPH	*Delphinium*	0–7	0–1
	fleabane	ERIGE2	*Erigeron*	0–7	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–7	0–1
	desertparsley	LOMAT	*Lomatium*	0–7	0–1
	lupine	LUPIN	*Lupinus*	0–7	0–1
	bluebells	MERTE	*Mertensia*	0–7	0–1
	beardtongue	PENST	*Penstemon*	0–7	0–1
	onion	ALLIU	*Allium*	0–7	0–1
	pussytoes	ANTEN	*Antennaria*	0–7	0–1
5	**Annual Forbs**			0–7	
	rockjasmine	ANDRO3	*Androsace*	0–7	0–1

	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–7	0–1
	Forb, annual	2FA	*Forb, annual*	0–7	0–1
Shrub/Vine					
6	**Shrubs**			14–35	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	14–35	1–10
7	**Misc Shrubs**			14–35	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–35	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–35	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–35	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–35	0–5
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–7	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–7	0–1
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–7	0–1
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–7	0–1

Table 21. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Grasses**			28–40	
	prairie Junegrass	KOMA	*Koeleria macrantha*	4–40	1–10
	muttongrass	POFE	*Poa fendleriana*	0–20	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–20	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–20	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–20	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–20	0–5
2	**Rhizomatous Grasses**			40–60	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	40–60	10–15
	western wheatgrass	PASM	*Pascopyrum smithii*	40–60	10–15
3	**Misc Grasses/Grasslikes**			40–60	
	Sandberg bluegrass	POSE	*Poa secunda*	20–40	5–10
	Grass, perennial	2GP	*Grass, perennial*	0–20	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–20	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	4–20	1–5
	cheatgrass	BRTE	*Bromus tectorum*	0–4	0–1
Forb					
4	**Perennial Forbs**			20–36	
	buckwheat	ERIOG	*Eriogonum*	4–20	1–5
	spiny phlox	PHHO	*Phlox hoodii*	4–20	1–5
	bluebells	MERTE	*Mertensia*	0–12	0–3
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	4–12	1–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–12	0–3
	rockcress	ARABI2	*Arabis*	0–12	0–3

	sandwort	ARENA	*Arenaria*	0–12	0–3
	milkvetch	ASTRA	*Astragalus*	0–12	0–3
	Indian paintbrush	CASTI2	*Castilleja*	0–4	0–1
	onion	ALLIU	*Allium*	0–4	0–1
	pussytoes	ANTEN	*Antennaria*	0–4	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–4	0–1
	violet	VIOLA	*Viola*	0–4	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–4	0–1
	larkspur	DELPH	*Delphinium*	0–4	0–1
	fleabane	ERIGE2	*Erigeron*	0–4	0–1
	desertparsley	LOMAT	*Lomatium*	0–4	0–1
	lupine	LUPIN	*Lupinus*	0–4	0–1
	beardtongue	PENST	*Penstemon*	0–4	0–1
	sagebrush buttercup	RAGL	*Ranunculus glaberrimus*	0–4	0–1
5	**Annual Forbs**			0–4	
	madwort	ALYSS	*Alyssum*	0–4	0–1
	rockjasmine	ANDRO3	*Androsace*	0–4	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–4	0–1
	Forb, annual	2FA	*Forb, annual*	0–4	0–1
Shrub/Vine					
6	**Shrubs**			100–160	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	100–160	10–25
7	**Misc Shrubs**			28–40	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–20	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–20	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	4–20	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–4	0–1
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–4	0–1
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–4	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–4	0–1
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–4	0–1

Animal community

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity, but recovery time for upland sites is much longer than in a low intensity system. If distribution problems occur, stocking rates must be reduced or facilitating conservation practices (i.e. cross-fencing, water development) to maintain plant health and vigor.

Plant Community Production Carrying Capacity*

(lb./ac) (AUM/AC) (AC/AUM)
Big Sagebrush/Bunchgrass (Reference) 500-700-900 (.10) (10)
Bunchgrass/Big Sage 500-700-900 (.12) (8)
Bunchgrass 500-700-900 (.13) (8)
Big Sage/Rhizomatous Wheatgrass 200-400-650 (.05) (20)
Big Sage/*Bare Ground* 100-300-500 (.03) (33.3)
Rabbitbrush/*Bare Ground* 100-300-500 (.03) (33.3)
Big Sage/Rabbitbrush 100-300-500 (.03) (33.3)
* - Continuous, season-long grazing by cattle under average growing conditions.

**Calculation for stocking rates are as follows: using RV values for production, take forage palatable to grazing cattle multiply by 0.25 harvest efficiency and divide by 912.5 (air dried weight) to arrive at carrying capacity.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect grazing capacity within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than 1 mile from water; therefore the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Wildlife Community

The Loamy (Ly) ecological site in 34A Cool Central Desertic Basins and Plateaus, LRU I (Platte Valley) provides suitable and valuable habitat for a variety of wildlife species. In most cases, the greater the density and diversity in grass, forb, and shrub species within the site, the greater the diversity of wildlife the site can support including insects which many wildlife species depend on for their dietary requirements.
Mid-sized cool season bunchgrasses provide forage and cover for big game species, small mammals, birds, and reptiles. Wildlife such as elk, cottontails, jackrabbits, and prairie dogs depend largely on grass for forage. Birds nest among the bunchgrasses and utilize the grass as screening cover from predatory wildlife. Mule deer, pronghorn, greater sage-grouse, and songbirds utilize the taller grasses amongst the shrubs as hiding cover for their young. Sagebrush, which can approach 15% protein and 40-60% digestibility, provides important winter forage for greater sagegrouse, mule deer, and pronghorn. Yearround habitat is provided for sage-grouse and other sagebrush obligate species such as cottontails, pygmy rabbit, sagebrush vole, shorthorned lizard, and pronghorn. Seasonal habitat needs are provided for migrants such as sage sparrow, Brewer's sparrow, and sage thrasher and other sagebrush obligate songbirds.. Other birds that frequent this plant community include horned larks and golden eagles.

Forbs are an important component of this habitat type, providing an early food source for sage-grouse chicks both nutritionally and via the insects that forbs attract. Forbs provide necessary moisture to wildlife in arid landscapes. Mule deer and pronghorn are dependent on abundant forbs to aid in the production of milk to nurse fawns and as forage for fawn development and health.

Reference State:

1.1 Big Sagebrush/Bunchgrass: This plant community provides optimal winter habitat for sage-grouse, mule deer, pronghorn, and other species that depend on shrubs that stand up through the snow for forage. These areas also provide high quality bird nesting habitat where sagebrush canopy and residual bunchgrasses hide nests and young from predators. Forbs are necessary in the understory of this plant community to attract insects that are a highly nutritious spring food source for sage-grouse chicks and other sagebrush obligate bird species.

1.2 Bunchgrass/WY Big Sagebrush: This vegetation community tends to have higher herbaceous plant diversity that may attract more diverse wildlife use. The state provides suitable forage and cover for sagebrush

obligate species. The more open canopy promotes higher diversity and quantity of forbs that are important for early sage-grouse broodrearing habitat. A reduced sagebrush canopy may result in a slightly lower nesting frequency by sagegrouse and songbirds. Winter use by mule deer and pronghorn may be significant and some shrubs may become hedged over time with excessive browsing. Yearlong elk use in these areas can be high due to the abundance of bunchgrass.

1.3 Bunchgrass Community: This plant community provides foraging habitat for sagegrouse when in proximity to areas with denser sagebrush cover. Due to the higher production of perennial cool-season grasses, this vegetation type provides high forage value for wintering elk. Mule deer and pronghorn may transition through these habitats during their annual migrations between summer and winter ranges. It also provides suitable habitat for burrowing animals.

Grazing Resistant State:

2.1 Big Sagebrush/Rhizomatous WheatgrassSandberg BluegrassMat Forb: This plant community is variable in its value to wildlife. The value of the sagebrush community is similar to the reference state but the value of the grass community decreases. In periods of high plant vigor, the grass plants can provide cover for nesting birds and small mammals. In periods of drought and low plant vigor and diversity, especially low forb availability, grass plants are too short and not dense enough to provide adequate cover and the wildlife value of these areas declines. Mat-forming forbs often occupy the space and nutrients needed for more desirable forbs such as globemallow, bitterroot, and yarrow.

Eroded State:

3.1 Big Sagebrush/*Bare Ground*: This plant community provides suitable winter habitat for foraging big game and sagegrouse when sagebrush is in a healthy state and stands above winter snows. The lack of herbaceous species limits the value of the site for birds and small mammals due to the lack of cover in the interspaces of the sagebrush plants. The lack of plant diversity limits the diversity of insects used by wildlife species.

Disturbed State:

4.1 Rabbitbrush/*Bare Ground*/Annuals: This plant community is capable of producing a high number of insects which are important for pollination and bird forage. In some areas, rabbitbrush is used heavily by wintering mule deer, especially when other preferred winter forages are unavailable or in poor vigor due to over-use or drought. Annual plants have little nutritive value and are typically too short to provide hiding cover for wildlife. Big game animals may garner some early spring or fall benefit from newly sprouted annual forage, but the timing is short where wildlife can benefit, especially from cheatgrass sprouts. Chukars are a species that utilizes cheatgrass seed as a food source, and they may benefit from areas of cheatgrass invasion. This state is vulnerable to repeated wildfire which can result in a complete loss of value for wildlife. Bare ground provides essentially no habitat value for wildlife. In addition, bare ground may be more susceptible to invasion of non-native species, further degrading the value for wildlife.

4.2 Big Sagebrush/Rabbitbrush: The value of the big sagebrush in this state is similar as described in the previous states. Depending on the subspecies of rabbitbrush found in this plant community it can provide forage value in transitional and winter ranges for big game species. Sage-grouse and other birds may forage within this plant community where insect quantity and diversity is high. The lack of an herbaceous community limits the value as bird and small mammal hiding cover and forage for grazing animals.

Highly Disturbed State:
5.1 Annuals/*Bare Ground*: As described in the Rabbitbrush/*Bare Ground*/Annuals state above, annuals and bare ground hold little value for wildlife due to the lack of suitable forage and cover. This state is vulnerable to an increase in weedy species that can migrate into adjacent areas, degrading the adjacent areas' value for wildlife.

5.2 Reclaimed: How the site was reclaimed, the species planted, and the time it takes for plants to establish will determine the value of the site for wildlife. A fully reclaimed site containing a diversity of herbaceous and woody plants should provide the same wildlife habitat benefits as the reference state. In most cases, grasses and forbs

establish early in the reclamation process, whereas shrubs take significantly longer to establish. Wildlife species dependent on a herbaceous plant community for forage and cover (elk, prairie dogs, chukars, and swift fox) will benefit from reclamation sooner than those species dependent on a shrub/grass community. Suitable habitat for wildlife species which require tall, dense sagebrush (greater sage-grouse, pronghorn, mule deer, and sagebrush obligate songbirds) will likely not benefit from reclamation for a decade or longer, providing shrub species were planted and/or seed from shrubs adjacent to the area have established on-site.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B (infiltration rate of 0.15-0.3 in/hr), with localized areas in hydrologic groups A (infiltration rate of 0.3 in/hr) and C (infiltration rate of 0.05-0.15 in/hr). Infiltration ranges from rapid to moderate. Runoff potential for this site varies from low to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses and shrubs. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogrammic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, bird watching, and upland game hunting. The forbs have a variety of colors and shapes that appeal to photographers. This site provides valuable open space when located in large, unfragmented landscapes

Wood products

NONE

Other products

NONE

Other references

Bestelmeyer, B., & Brown, J. (2005). State-and-transition models 101: a fresh look at vegetation change. The Ouivira Coalition Newsletter, Vol. 7, No. 3.
Bestelmeyer, B., Brown, J., Havstad, K., Alexander, B., Chavez, G., & Herrick, J. (2003). Development and use of state and transition models for rangeland. Journal of Range Management, 56(2): 114-126.
Bestelmeyer, B., Herrick, J., Brown, J., Trujillo, D., & Havstad, K. (2004). Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management, 34(1): 38-51.
Carney, J., Bainter, E., Budd, B., Christiansen, T., Herren, V., Holloran, M., et al. (2010). Grazing Influence, Objective Development, and Mangement in Wyoming's Greater Sage-Grouse Habitat. Unpublished, 36.
Derner, J. D., Schuman, G. E., Follett, R. F., & Vance, G. F. (2014). Plant and Soil Consequences of Shrub Management in a Big Sagebrush-Dominated Rangeland Ecosystem. Environment and Natural Resources Research, 19-30.
Natural Resouces Conservation Service. (n.d.). USDA Plants Database. Retrieved from http://plants.usda.gov/java/
Sommers, J. (1994). Green River Drift- A History of the Upper Green River Cattle Association. ISBN: 1-56044-280-8.
Stiver, S., Rinkes, E., & Naugle, D. (2010). Sage-Grouse Habitat Assessment Framework. Unpublished, 100-106.
Stringham, T., Kreuger, W., & Shaver, P. (2003). State and transition modeling: an ecological process approach. Journal of Range Management, 56(2): 106-113.
Winward, A. (2007). Boulder, Squaretop Area Field Notes. Unpublished.

Approval

Kirt Walstad, 9/28/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Wyoming NRCS Wyoming BLM Wyoming State Lands Wyoming Game and Fish Department George Gamblin, WY NRCS Mark Shirley, WY NRCS Dan Perkins, NRCS Andy Warren, WY BLM Cheryl Newberry, WY BLM Maureen Hartshorn, WY BLM Mike Henn, WY State Lands
Contact for lead author	Bryan Christensen MLRA 34A SSO 1625 W Pine Street Pinedale, WY 82941 307-367-2257 bryan.christensen@wy.usda.gov
Date	09/30/2015
Approved by	Scott Woodall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Not common, but can be present, particularly at the upper end of the slope range for this site. When present, rills are short and widely spaced relative to slope distance.

---

2. **Presence of water flow patterns:** Water patterns can be present, but are very small and not connected beyond 2 gaps in the plant canopy.

---

3. **Number and height of erosional pedestals or terracettes:** Existing pedastals are blunt and not active, less than 2 inches (5cm) and typically found at the drip line of the shrub canopy. Terracettes are not present.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**): Bare ground is typically <30%, but can be dependent on plant community phase within the reference state. Higher bare ground is expected directly following a sagebrush killing disturbance, but returns to <30% within 2 years post-disturbance. Canopy gaps comprise <20% of the ground surface, and are primarily in the 1-2 foot category

(>70%). No canopy gaps >6 feet should be present.

---

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present on this site, but sometimes there is erosion or deposition associated with adjacent steeper sites.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** Minimal wind scour or deposition may be present with wind scour found in canopy gaps and deposition found on the leeward side of shrubs. It is only occasional and does not occur as repeating pattern across the landscape, but is localized to exposed topography.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter expected to move only in small amounts (to leeward side of shrubs) due to wind. Large woody debris from sagebrush will show no movement except for minimal debris damming after large rain or snowmelt events on slopes >6%.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings are highly variable. Values of 6 are typical when sample includes soil biological crusts, but are often 1 when a sandy loam cap exists on the site. When consistent values of 6 are encountered, it is important to consider if the soil surface has degraded to the argillic subsurface layer (higher clay content will result in higher soil stability). Overall, the biotic component (plants and soil biological crusts) provide stability for this site.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil organic matter (SOM) <2% is common. Typically soil surface consists of an A-horizon of 3-12 inches (7-30 cm) thick with weak to medium sub-angular blocky or sometimes granular or platy structure that is brown to grayish brown (i.e. 10YR 5/3 or 5/2) in color. Field indicators of departure from the reference condition include exposure of subsoil as evidenced by excessive pedastalling and/or surface disturbance.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The reference state consists of 20-60% grasses, 5-15% forbs, and 5-50% shrubs composition by dry weight. The sagebrush canopy is evenly distributed with cover ranging from 5-25%. When sage canopy is at the high end, herbaceous understory diminishes in the plant interspaces, but desirable bunchgrasses can still be found in the interspaces of sage canopy as well as litter to reduce runoff potential. Infiltration is moderate to moderately rapid infiltration rates resulting in minimal runoff. Basal cover is typically less than 5% for this site and does very little to effect runoff on this site.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. A coarse, dry subsurface will often refuse a probe, causing misidentification of a compaction layer. Most soil profiles must be described by hand dug holes.

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant: Mid-size, cool season bunchgrasses

Sub-dominant: cool season rhizomatous grasses=perennial shrubs>perennial forbs>short, cool season bunchgrasses

Other:

Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence can be observed and is typically associated with shrub component. It is common to find dead matter accumulated in bunchgrasses such as Indian ricegrass, but live plant matter quantity should exceed standing dead except for in times of severe drought. Sagebrush canopy will often have occasional dead branches, but it should not exceed 10% or be found on most plants.

---

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-35% of total canopy measurement with total litter (including beneath the plant canopy) 30-60% expected. Herbaceous litter depth is typically very shallow, approximately 1-2mm. Woody litter can be up to a couple inches in diameter (4-6cm), but is sporadically distributed.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 350-700 lb/ac (500 lb/ac average); Metric: 159-318 kg/ha (227 kg/ha average).

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Bare ground greater than 50% is the most common indicator of a threshold being crossed. When dominant, rabbitbrush, which is typically found in small quantities on this site, indicates a change in disturbance regime and a threshold being crossed. Greasewood commonly invades this site when adjacent to a drainage bottom. Annual weeds such as cheatgrass, halogeton, kochia, lambsquarter, flixweed, and Russian thistle are common invasive species in disturbed sites.

---

17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in drought years. Western wheatgrass will commonly reproduce by underground rhizomes and not by seed production.
